The VITAL project: Visual Information Translation Analysis & Learning in Life Sciences

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Abstract

In many disciplines of science, especially in life sciences, research proceeds in a top-down approach, in which domain experts formulate hypotheses that are tested on relevant data. In contrast, research in Computer Science and Engineering often follows a data-driven bottom-up approach. In the bottom-up approach, various algorithms and computational tools are designed and utilized to perform unstructured knowledge discovery such as finding patterns and structure in data.

In this presentation we give an overview of our research activities, namely how we combine novel bottom-up **Computer Vision** and **Machine Learning** methods with top-down domain knowledge in **Physiology**, **Neuroscience** and **clinical Medicine** to engender knowledge discovery. Specifically, we present our efforts towards answering the following questions:

how

does brain control breathing?

do genes control locomotion and touch sensation?

can we reconstruct a model brain at single-cell resolution?

can we model protein-protein interactions in neurons, *in situ*?

can we predict the biological effect of growth factor-delivering scaffolds for promoting angiogenesis?

can we combine Magnetic Resonance imagery and biochemical spectroscopy for brain tumor radiation treatment planning?

The VITAL project (PI: Tsechpenakis - web.mac.com/gavriil) is a new research group, part of the Center for Visual Information Sensing and Computing (visc.cs.iupui.edu) at the Computer Science Department of IUPUI. The core theoretical background of our modeling and analysis methods is in Computer Vision, applied Machine Learning, Imaging and Signal Processing. Currently our research is funded by two NIH grants and the IUPUI School of Science; the PI's research has been previously funded by NIH, NSF, NOAA, and the Wallace H. Coulter Foundation.